EXECUTIVE SUMMARY

A project on the 'Survey and Mapping of Commercially Important Medicinal Plants in the state of Uttarakhand' was initiated in the month of February 2008. The project was funded by the Uttarakhand Forest Department (UKFD), Government of Uttarakhand. This report deals with the major findings of the rapid survey of high value medicinal and aromatic plants (MAPs) conducted in different Forest Divisions of Garhwal region. The following aspects have been dealt with: (i) General floristic inventory and composition in different Reserved Forests in Garhwal, (ii) Status of MAPs in representative areas of different Forest Ranges following rapid mapping exercise (RME) and random sampling; (iii) information on the use and distribution of select high value MAPs; Based on sample surveys and additional information collected during field work, distribution maps of high values MAPs have been prepared in three density classes *i.e.*, high, medium and low. Based on the status and distribution of high value MAPs, recommendations have been given for the conservation and management of such species.

Major objectives of the project were as follows:

(i) To quantify the availability of commercially important medicinal plants in various Forest Divisions of Uttarakhand (Garhwal region),

(ii) To generate a spatial database on the distribution and abundance of medicinal plants for future monitoring and conservation planning, and

(iii) To evolve strategies for sustainable harvest of medicinal and aromatic plants in the state.

Availability and extraction pattern of commercially important species were quantified using the techniques of Rapid Mapping Exercise (RME) evolved by Rawat et al. (2004). Rapid survey of MAPs were conducted in various Forest Divisions of Garhwal region during 2008 – 2011. Overall, 15 Forest Divisions (81 ranges) were surveyed covering four distinct ecological zones *viz*., Sub-tropical, Temperate, Sub-alpine and Alpine. 582 transects (1-2 km long) were laid covering these Forest Divisions. In all, 559 species of MAPs have been recorded in the survey Divisions. Density, frequency and abundance values of 97 high value species (12 species of trees, 15 shrubs, 9 climbers and 61 herbaceous) have been computed and given in Chapter 4. 87 tree, 112 shrubs, 38 climbers and lianas and 225 herbaceous species were recorded during survey. Status of high value MAPs in various Forest Divisions have been summarized below:

Badrinath Forest Division (BFD): This Division has more than 45 species of medicinal plants. Important areas for conservation and development of MAPs are as follows:

(i) Chamoli Range: Dasoli VIII N (compartment 13 & 14) and S (compartment 10 & 14) Blocks in Chamoli Range for *Aconitum ferox*, *A. hetrophyllum*, *Allium humile*, *Angelica archangelica*, *Arnebia benthamii*, *Dactylorhiza hatagirea*, *Jurinea dolomiea*, *Maharanga emodii*, *Malaxis acuminata*, *Meconopsis aculeata*, *Nardostachys grandiflora*, *Juniperus indica*, *Paeonia emodii*,

Picrorhiza kurrooa, *Podophyllum hexandrum*, *Polygonatum cirrhifolium*, *Rheum australe*, *R. moorcraftianum*, *R. webbianum*, *Skimmea anquetilia*, *Tanacetum dolichophyllum, Trillidium govanianum* and *Valeriana hardwickii.* Dasoli VIII N - 8 & Dasoli VIII S - 10 have very good patches of *Taxus wallichiana* and *Skimmia anquetilia*. Dasoli VIII S 10 to 14 (areas above Irani, Salurdhar, Semkhark, Brahmkund villages) may also be taken up for conservation of these species.

(ii) Nandprayag Range: In this Range, from Kanol village to Rupkund via Palbala bugyal (Bhuna) has good populations of MAPs such as *Dactylorhiza hatagirea*, *Jurinea dolomiea*, *Meconopsis aculeata*, *Nardostachys grandiflora*, *Picrorhiza kurooa*, *Polygonatum cirrhifolium*, *Tanacetum dolichophyllum,* and *Valeriana hardwickii.* Nandakini I - 10b and 15 and are especially recommended for conservation and development of these species. Nandakini I Block of Bhuna beat, compartment number - 15 can be considered for the conservation of S*aussurea costus* (Kuth). In this compartment it grows wild and has good population, spread over an area of 500x500m. Possibly, this species has escaped into wild from a nearby nursery and as such, there is no other place in Uttarakhand where Kuth is found in wild. Hence this patch of forest is recommended for conservation of Kuth. Nandakini - I compartment 3b can is recommended for for conservation and development of species like *Berginia ciliata*, *Dioscorea deltoidea*, *Lilium polyphyllum* and *Myrica esculanta*.

(iii) Pindar Central: On way to Baramtal from Ratgav, *Angelica glauca, Berberis aristata* and *Skimmea anquetilia* have patchy distribution in Pindarpar II - 20 and it is recommended for conservation and development of these species. *Thaliactrum javanicum*, *Berberis asiatica* and *Hedychium spicatum* have good population in Pindarpar – I 24. Devsari IV - 2b and Pindarpar II - 20 are recommended for for conservation and development of above mentioned species. *Datisca cannabina* was found in pine forest (outside RF) between Tharali (3 km away from Lisa Depot) and Dungri village.

(iv) Pindar East: This Range is very important from MAPs point of view. Species such as *Allium stracheyi*, *Angelica archangelica*, *Dactylorhiza hatagirea*, *Jurinea dolomiea*, *Juniperus communis*, *J. indica*, *Meconopsis aculeata*, *Nardostachys grandiflora*, *Paeonia emodii*, *Picrorhiza kurooa*, *Podophyllum hexandrum*, *Polygonatum cirrhifolium*, *R. moorcraftianum*, *R. webbianum*, *Skimmea anquetilia*, *Tanacetum dolichophyllum* and *Trilidium govanianum* have fairly good populations in Pinderpar IV - 9 and 10, Nawali I - 16 and Nawali V - 1a, 14b and 16 and can be considered for conservation and development of these species (these Blocks have Bedani, Ali above Wan village and Bagachi bugyals above Ghes and Himani villages). *Aconitum heterophyllum, Podophyllum hexandrum, Taxus wallichiana* and *Trilidium govanianum* are found in Kharsu oak forests below Bedini bugyal on way to Wan. Pinderpar IV - 7 and 11 are recommended for conservation and development of these species. Above Kheta village on way to Ghesh or Bagachi Bugyal open grassy patch (Sorigad beat - Nawali V - 4) is very much important for *Berberis osmastonii* (endemic to Uttarakhand) and *Onosma pyramidale* found only in two place in the state and only location in Garhwal, needs to be conserved (Tiwari *et al.* 2011).

(v) Pindar West: This Range is dominated by steep grassy steep slopes. *Asparagus adscendens*, *Berberis asiatica*, *Canabiis sativa*, *Malaxis acuminata* and *Plectranthus barbatus* have good populations in Pindarwar III - 7a. Hence this area is recommended for conservation of these species. *Emblica officinalis* and *Satyrium nepalense* have good populationsin Pindarwar II - 8b. *Zanthoxylum armatum* is more common in Kunjakot - 11 and 12 and recommended for the conservation and development of the species. Nalgaon – 8 harbours good populations of *Boerhavia diffusa* and has potential for conservation and development and after proper assessment, can be recommended for limited harvest on the rotation of 2-3 years along with proper monitoring.

Note: In Badrinath Forest Division - Dasoli VIII N (compartment 13 and 14) and S (compartment 10 and 14), Pinderpar IV - 9 and 10, Nawali V - 1a, 14b and 16 are recommended for conservation and development of high altitude and sub-alpine MAPs. Pindarwar III - 7a can be considered for conservation and development of temperate species. Likewise, Nandakini I - 15 can be taken up for conservation of *Kuth.* Sorigad beat - Nawali V - 4 is recommended for conservation of endemic and rare species such as *Berberis osmastonii*, *Onosma pyramidale* and *Berberis rawatii*.

Chakrata Forest Division (CFD): Fourteen species of MAPs, viz., *Adhatoda zeylanica, Anemone rivularis, Artemissia roxburghii, Berberis aristata, Bergenia cilliata, Embelia tsjeriam-cottam, Geranium wallichianum, Hedychium spicatum, Myrica esculenta, Oroxylum indicum*, *Skimmea anquetilia*, *Swertia chirayita, Swertia cilliata* and *Valeriana jatamansii* were located, inventoried and identified for inclusion in Conservation, development and Harvest (CDH) plans in the various Ranges of this Division. Summary of findings for each Range are as follows:

(i) Bawar Range: Mundali Block can be considered for development of *Berberis aristata* and conservation and development of *Artemisia roxburghii.* Dharmigad Block is recommended for further restocking and propagation of *Valeriana jatamansii.*

(ii) Deoghar Range: Chandnigad , Murach and Sangared Blocks are ideal places for conservation as well as development of *Swertia ciliata, Skimmea anquetilia* and *Geranium wallichianum*, respectively.

(iii) Kanasar Range: Deoban Block is rich in *Skimmea anquetilia* and after re-assessment it can be considered for control and rotational - sustainable harvest. It can also be considered for development of *Swertia chirayita* and *Valeriana jatamansii.* Kunain Blocks has a potential for development of *Anemone rivularis* and *Valeriana jatamansii.* Kanasar Block can be considered for development of *Hedychium spicatum.*

(iv) Molta Range: Khunigad Block can be considered (after re--assessment) for sustainable harvest along with development of *Myrica esculenta* and conservation and development of *Artemissia roxburghii, Geranium wallichianum, Hedychium spicatum* and *Swertia ciliata.* Dhanras Block has a potential for production of *Artemissia roxburghii* and *Bergenia ciliata.*

(v) Rikhnar Range: Ekra Block is recommended for conservation of *Swertia chirayita, Valeriana jatamansii* and *Swertia ciliate.*

(vi) River Range: Kalsi Block is suitable for sustainable harvest (after re-assessment) of *Adhatoda zeylanica* and development of *Adhatoda zeylanica* and *Oroxylum indicum.*

Note: Deoban and Khunigad Blocks have maximum diversity of MAPs in Chakrata FD and can be considered for conservation and development.

Dehra Dun Forest Division (DFD): In this Division 14 species have been identified for Conservation, development and Harvest (CDH) plans. These species are *Adhatoda zeylanica, Abrus precatorius, Acacia catechu, Asparagus adscendens, Curculigo orchioides, Embelia tsjeriam-cottam, Mallotus philippensis, Vallaris solanacea, Baliospermum montanum, Tinospora cordifolia, Plumbago zeylanica, Myrica esculenta* and *Oroxylum indicum*.

(i) Asarori Range: Karwapani East area is suitable for conservation and development of *Mallotus philippensis*. Arcadia Block is recommended for the conservation of *Baliospermum montanum.*

(ii) Barkot Range: Ranipokhri Block has the potential for conservation and development of *Acacia catechu, Adhatoda zeylanica, Curculigo orchioides, Mallotus philippensis,* and *Vallaris solanacea* and can be recommended for sustainable harvest of these species. *Vallaris solanacea,* after re--assessment, is recommended for limited harvest. Golatapper Block is recommended for conservation and development of *Rauvolfia serpentina*.

(iii) Jhanjhara Range: Majhaun Block has potential for development of *Baliospermum montanum* and *Tinospora cordifolia*. Kandoli Block has sizeable populations of *Tinospora cordifolia* and recommended for conservation and development of the species.

(iv) Lachiwala Range: *Adhatoda zeylanica* and *Vallaris solanacea* are widely distributed and can be recommended for sustainable harvest of these species on rotational basis. Dudhli and Lachiwala Blocks also have potential for development of *Baliospermum montanum*.

(v) Malsi Range: Galjwari Block can be considered for the conservation and development of *Abrus precatorius* and *Terminalia chebula*.

(vi) Rishikesh Range: *Adhatoda zeylanica* is widely distributed and abundant in this Range. Hence this Range can be recommended for sustainable harvest of the species on rotational basis. Bibiwala and Gola Blocks are recommended for development of *Baliospermum montanum* and *Rauvolfia serpentina*

(vii) Thano Range: *Adhatoda zeylanica* is widely distributed in Lambirau, Nahi, Saura and Bhogpur Blocks and entire range has a potential for sustainable harvest of this speices. Ladwakot Block for *Myrica esculenta*, Bhogpur Block for *Adhatoda zeylanica* and *Abrus precatorius,* Lambirau Block for *Curculigo orchioides* and *Vallaris solanacea,* Nahi Block for *Plumbago zeylanica* and *Vallaris solanacea,* Paled Block for *Adhatoda zeylanica, Embelia tsjeriam-cottam, Plumbago zeylanica* and *Vallaris solanacea* can be considered for conservation and development.

Note: In general, Lambirau, Nahi and Ranipokhari Blocks can be considered for conservation and development of various sub-tropical species.

Garhwal Forest Division (Pauri): For this Division, 16 species have been identified for conservation and development. These are as follows: *Aconitum lethale*, *Asparagus adscendens, Hedychium spicatum, Bergenia ciliata, Dioscorea deltoidea*, *Taxus wallichiana, Geranium wallichianum, Swertia ciliata, Valeriena jatamansi, Thaliactrum javanicum*, *Asparagus racemosus, Myrica esculenta, Artemisia roxburghii, Berberis aristata, Plectranthus barbatus* and *Viola serpens*.

(i) Diba Range: Dibadanda II - 1 and Dibadanda I - 4 are recommended for the conservation and development of *Asparagus adscendens*, after proper re-assessment (10-20% of the population may safely harvested. Dibadanda I - 10 of Dhumakot beat has very good population of *Hedychium spicatum* and recommended for its development and sustainable (10 – 20%) harvest.

(ii) East-Ameli Range: Dhudhatoli IV (N) - 19 and 20 have good potential for the conservation and development of *Artemisia roxburghii*, *Berberis aristata, Hedychium spicatum, Bergenia ciliata, Taxus wallichiana, Geranium wallichianum, Potentilla fulgens, Swertia ciliata, Valeriena jatamansi* and *Viola serpens*. Harvestible populations of *Artemisia roxburghii*, *Hedychium spicatum, Bergenia ciliata, Swertia ciliata, Valeriena jatamasii* and *Viola serpens* are available in Dhudhatoli IV (N) Block after re-assessment. In Musakor - 20 (Ghuri beat) and Bhabarpani compartment - 10 (Kodiyabagad beat) few individuals of *Aconitum lethale* were seen which need immediate conservation measures.

(iii) Pathani Range: Panjikhal - 10 and 14 and Dhudhatoli - 13 and 14 are recommended for the conservation and development of *Hedychium spicatum, Bergenia ciliata, Geranium wallichianum, Potentilla fulgens, Swertia ciliata, Valeriana jatamansi* and *Viola serpens.*

(iv) Pauri Range: Uli - 38 is recommended for the conservation of *Asparagus racemosus*. Sigad - 8, North Khirsu II - 3 and North Khirsu III - 25 has very good populations of *Hedychium spicatum* and *Myrica esculenta.* These compartments are therefore, recommended for the CDH after 3 - 4 years protection. North Khirsu II - 3 is recommended for the conservation and development of species such as *Viola serpens, Thalictrum javanicum, Valeriana jatamansi, Swertia ciliata* and *Dioscorea deltoidea*.

(v) Pokhra Range: Gwari - 5 and 6, Ameli V - 6 and 10 are recommended for the conservation and development of *Artemisia roxburghii* and *Asparagus adscendens,* and after 2-3 years of protection, this area could yield harvestable populations of these species. Ameli V - 6 and Ameli IV - 15 are recommended for the conservation and development of Patharchur (*Coleus barbatus*).

(vi) West-Ameli Range: *Artemisia roxburghii, Berberis asiatica, Hedychium spicatum* and *Valeriena jatamansii* can be conserved and developed in Ameli – VI - 2, Ameli VII - 4, Ameli VIII - 14 and Ameli – IX – 31. These species are expected to attain harvestable population after 4-5 years of conservation and development.

Dhudhatoli IV (N) Block of East Ameli Range and Panjikhal Block of Pathani Range are characterized by their intact Temperate Broadleaf Forests and rich array of floral and faunal diversity. Almost all the species recorded within Garhwal FD can be seen in these two blocks. Hence, these forests need special conservation measures and long term monitoring.

Haridwar Forest Division: For this Division 8 species have been prioritized for conservation and development. These species are *Asparagus adscendens*, *Aegle marmelos*, *Emblica officinalis*, *Oroxylum indicum, Terminalia bellirica* and *Vallaris solanacea*. Haridwar and Laxar Ranges have no Reserved Forests and hence RME was not conducted. Chandi - 4, Shyampur – 8, Kotawali - 4 (Shyampur Range) and Rasiyabad - 5 and 7 (Jhilmil Jheel Conservation Reserve) have excellent potential for conservation and development of several MAP species mentioned above.

(i) Chiriyapur Range: Kotawali - 5b and Kotawali - 4 are recommended for the conservation and development of *Aegle marmelos, Oroxylum indicum* and *Stereospermum suaveolens.* One of these Blocks may be developed for production of fruits / seeds of these species.

(ii) Jhilmil Jheel Unit: Rasiyabad - 5 and 7 are recommended for the conservation and development of *Litsea chinensis* and *Terminalis bellirica*.

(iii) Khanpur Range: Sakrauda - 2a (i) is recommended for the conservation and development of *Emblica officinalis, Adhatoda zeylanica* and *Vallaris solanacea*. Though, the population of these species is low at present but they could be easily restocked and sustainably harvested in future.

(iv) Shyampur Range: Chandi - 4, Shyampur – 8, and Kotawali - 4 are recommended for the conservation and development of *Aegle marmelos,* , *Cissampelos pariera, Oroxylum indicum, Terminalia bellirica* and *Embelica officinalis.* Fruits of *T. bellirica*, *A. marmelos* and *M. philippensis* can be harvested in organized way from this range once in three years under close supervision of Range Officer Peli 2a (ii) is recommended for organized harvest of *Adhatoda zeylanica* and conservation and development of *Vallaris solanacea*.

Kalsi soil Conservation Division: 15 species of MAP have been identified for conservation, development and to a limited extent sustainable harvest in this Division. These include *Aegle marmelos*, *Rauwolfia serpentina, Tinospora cordifolia, Terminalia bellirica, T. chebula*, *Vallaris solanacea* and *Emblica officinalis.*

(i) Timli Range: Timli - 9 and 10, Majari – 1, Dararith - 5a, b and 7a are recommended for the conservation and development of *Terminalia chebula*, *T. bellirica*, *Tinosopra cordifolia* and *Vallaris solanacea*. These species have very good population in these compartments and should be taken for preparation of conservation and development planning. Dharmawala - 9a and Majri - 3, 6, 9b and 10b have few individuals of *Rauwolfia serpentina* and recommended for further conservation and development of species. Majri 1, 2 & 3a are recommended for the conservation of *Terminalia chebula*, *T. bellirica, Emblica officinalis* and *Acacia catechu*.

Kedarnath Wildlife Division: This division has very wide altitudinal range. Prominent species of MAPs recorded in the Division include: *Asparagus adscendens*, *Bergenia ciliata, Cinnamomum tamala, Plectranthus barbatus, Rubia cordifolia, Taxus wallichiana, Lilium polyphyllum, Hedychium spicatum, Valeriana hardwickii, Polygonatum verticillatum, Cissampelos pariera, Emblica officinalis, Myrica esculenta, Viola serpens* and *Terminalia chebula.*

(i) Gopeshwar Range: Trishula I - 11 is recommended for the conservation and development of *Bergenia ciliata* . This block can be used for experimental harvest of *B. ciliata* (10 – 20% population) with a rotation of three years and close monitoring of regeneration. Trishula I - 19a, 20a and 20b are recommended for the conservation and development of *Cinnamomum tamala,* and Trishula I – 11 for Pathar chur (*Plectranthus barbatus*). In Malla Nagpur I - 4c few individuals of *Lilium polyphyllum* were recorded, which need close monitoring and protection. Trishula I - 3 and 4 have high densities of *Emblica officinalis* and hence its fruits can be harvested on sustainable basis from here. Trishula I-10 and 11 are recommended for the conservation and development of *Asparagus adscendens*.

(ii) Nagnath Range: In this Range, Ragssi III 6a and 6b are recommended for the conservation and development of *Taxus wallichina*, *Polygonatum verticillatum* and *Valeriana jatamansii*. Mohankhal 2b and 3 are recommended for the conservation and development of *Rubia cordifolia*, *Hedychium spicatum* and *Viola serpens*. Nagnath - 11 has potential for development and harvest of *Myrica esculanta*.

(iii) Dhanpur Range: Dhanpur I - 7a and 7b is recommended for the conservation and development of *Inula cappa*, *Asparagus adscendens* and *Viola serpens*. After 2-3 years of development, re-assessment of populations, these species could be recommended for sustainable harvesting.

(iv) Lohba Range: Mehalchauri 13 to 16 are recommended for conservation and development of *Myrica esculanta.* At present, there is no record of annual fruit yield. After proper re-assessment limited harvest of fruits and stem bark (only from male trees) can be taken up on experimental basis. Jirkot - 11 is recommended for the conservation and development for *Terminalia chebula*, which has very good population and can be used for restoration of the species and development for the Division. Fruits can be collected after proper re-assessment on 2-3 years rotational basis.

Lansdowne Forest Division: In this Division as many as 15 species have been identified to be taken up for CDH plan in various Ranges. These species are *Cissampelos pariera, Embelia robusta , Mallotus philippensis, Terminalia chebula, Acacia catechu, Aegle marmelos, Terminalia bellirica, Vallaris solanacea, Abrus precatorius, Cissampelos pariera, Oroxylum indicum, Baliospermum montanum, Asparagus adscendens* and *Myrica esculenta.* Dabina 2 and 3 and Sighagadi Blocks are recommended for managing as 'Medicinal Plant Conservation Aeas' as for these Blocks have maximum diversity of MAPs.

(i) Dugadda Range: Dabina 2 and 3 are recommended for the development and harvest of *Cissampelos pariera* after 2-3 years rotation (10-20% population). North Kotadi - 18 is recommended for conservation and development of *Terminalia chebula*. Nauri - 1 is recommended for the development and harvest of *Mallotus philippensis* on rotation basis and proper re-assessment of species.

(ii) Kotdi Range: Saneh 8 and 12 are recommended for the conservation and development of *Acacia catechu, Aegle marmelos,* and Dudhibel (*Vallaris solanacea*). *A*fter 2-3 years CD on rotational basis fruits of bel and roots of Dudhibel can be extracted with proper re-assessment of species. *Terminalia bellirica* and *Mallotus philippensis* are quite frequent and have good potential for development and harvest in South Kotadi 19, 20 and 25b, fruits can be collected after a gap of every 4-5 years. South Kotadi - 19 is recommended for the development of Bahera and can be used as seed bank for the Division.

(iii) Kotdwar Range: Ratti (*Abrus precatorius*) was found in high abundance in Gwalgad - 3b. Hence this block is recommended for further seed production and sustainable harvest, *albeit* with repeated assessment and monitoring. Sukhrao - 2 has very good population of *Aegle marmelos* and is recommended for the development and harvest of species with a rotation of 4-5 years and regular re-assessment. Sighagadi - 18b is recommended for the development and harvest of *Oroxylum indicum*

(iv) Laldhang Range: *Aegle marmelos,* and *Baliospermum montanum* are potential species for Sighagadi - 7 and recommended for their conservation and development.

(v) Lansdowne Range: Silogi - 1 is recommended for the conservation and development of *Asparagus adscendens*, as it has very good populations here.

Mussorie Forest Division (MFD): Thirteen species *viz., Bacopa moneri, Emblica officinalis, Acaia catechu, Mallotus philippensis, Inula cappa, Asparagus adscendens*, *Bergenia ciliata, Hedychium spicatum, Swertia chirayita, Terminalia belerica, Zanthoxylum armatum, Valeriana jatamansii* and *Myrica esculenta* have been identified as key species to be taken up under CDH planning in various Ranges of the Division. Dwara, Dhanaulti and Bait Blocks are particularly rich in high value MAPs.

(i) Bhadrigad Range: Kori Block is recommended for conservation and development of *Valeriena jatamansii* and *Myrica esculenta.* Sila Block has potential to be developed for Timru (*Zanthoxylum armatum*).

(ii) Devalsari Range: Deolsari Block has high potential to be developed for *Zanthoxylum armatum.*

(iii) Jaunpur Range: Dhanaulti and Bait Blocks are recommended for conservation and development of *Hedychium spicatum.* Dhanaulti Block, in addition to Than and Bhal Blocks can be selected for conserving *Bergenia ciliata*, whereas Bait Block harbours *Valeriena jatamansii* and can be selected for conservation and development of these species. Magara Block can be selected for conservation and development of *Swertia chirayita.*

(iv) Kempty Range: Melgad Block is recommended for conservation and development of Triphala i.e., Harar, Bahera and Amla.

(v) Mussoorie Range: Rikholi Block has a potential to be developed for *Asparagus adscendens.*

(vi) Raipur Range: Dwara Block is suggested for the conservation and development of *Acacia catechu* and *Mallotus philippensis;* Ringalgarh Block for *Asparagus adscendens* and *Emblica officinalis.*

Narendranagar Forest Division (NFD): Twelve species *viz., Abrus precatorius, Bacopa monieri, Berberis aristata, Berberis asiatica, Emblica officinalis, Houttuynia cordata, Inula cappa, Mallotus philippensis, Myrica esculenta, Terminalia bellirica, Valeriena jatamasii* and *Vallaris solanacea* are identified for CDH planning in various Ranges of the Division.

(i) Maniknath Range: Chandrabani Block can be considered for conservation and development of *Emblica officinalis, Houttuynia cordata* and *Myrica esculenta.*

(ii) Saklana Range: Bagi, Pujargaon and Surkunda Blocks show good populations of *Berberis asiatica* and can be considered for development of this species. Surkunda Block is particularly rich in *Valeriena jatamansii.*

(iii) Shivpuri Range: Singtali Block is recommended for conservation and development of *Myrica esculenta, Terminalia bellirica* and *Vallaris solanacea.* Rotational and sustainable harvest of *Myrica esculenta* and *Vallaris solanacea* seems feasible in theses blocks after re-assessment.

Rudraprayag Forest Division: This is a rich Division in terms of diversity of MAPs. As many as 24 species have been recorded in various Ranges, *viz., Allium stacheyi, Anemone rivularis, Berberis aristata*, *Inula cappa*, *Tagetus minuta, Bergenia ciliata, Dioscorea deltoidea, Emblica officinalis*, *Geranium wallichianum, Maharanga emodii, Meconopsis aculeata, Malaxis acuminata*, *Myrica esculenta, Nardostachys grandiflora, , Picrorhiza kurrooa, Selinum wallichianum, Terminalia chebula*, *Trigonella emodi*, *Aconitum heterophyllum, Polygonatum multiflorum, Plectranthus barbatus, Taxus wallichiana*, *Cissampelos pariera* and *Trillidium govanianum*: Lastergad - 4, Narsing - 4, Rudraprayag - 1, Barma - 2, Taila - 5 and Naini Devi RF are particularly rich in MAPs.

(i) Agastyamuni Range: Maikhanda I - 3a for *Malaxis acuminata* and Maikhanda I - 4b for *Tagetus minuta* are recommended for the conservation and development of species. Naini Devi RF for *Taxus wallichiana* and Khetraswami II - 1 for *Berberis aristata* are recommended for further conservation and development.

(ii) Khankra Range: Chauras - 4 and 5 and Chattikhal - 1 are recommended for the conservation and development of *Aegle marmelos*, *Adhatoda zeylanica, Boerhaavia diffusa* and *Cardiospermum helicacabum*.

North Jakholi Range: Lastergad - 4 is recommended for the conservation and development of *Allium stacheyi, Anemone rivularis, Geranium wallichianum, Maharanga emodii, Meconopsis aculeata, Nardostachys grandiflora, Picrorhiza kurrooa, Selinum wallichianum,* and *Trigonella emodi.* Dharkuri - 9 is recommended for the conservation and development of *Aconitum heterophyllum, Polygonatum multiflorum* and *Trillidium govanianum*. Barma - 2 and Taila - 5 have potential for conservation, development and sustainable harvest of Patharchur (*Plectranthus barbatus*).

(iii) Rudraprayag Range: Rudraprayag - 1 has very good population of *Emblica officinalis*, *Inula cappa and Terminalia chebula* and recommended for the development and harvest of the fruits of *Emblica officinalis* and *Terminalia chebula.*

(iv) South Jakholi Range: Longa - 9b is recommended for the conserva*tion* and development of *Bergenia ciliata,* which has good population. Jakhni - 5b is recommended for the conservation and development of *Dioscorea deltoidea*. Narsing - 1b and 5 is recommended for the conservation and development of *Myrica esculenta*.

Tehri Forest Division: This one of the richest Divisions of Uttarakhand in the diversity of MAPs. More than 45 species of MAPs were recorded in the Division. Notable among them are: *Abrus precatorius*, *Aconitum heterophyllum*, *Aconitum lethale,* , *Allium stracheyi, Angelica archangelica*, *Angelica glauca*, *Aquilegia pubiflora*, *Asparagus adscendens*, *Berberis aristata*, *Berberis asiatica*, *Cissampelos pariera*, *Caltha palustris*, *Dactylorhiza hatagirea*, *Datisca cannabina*, *Geranium wallichianum*, *Habenaria intermedia*, *Hedychium spicatum*, *Lilium polyphyllum*, *Maharanga emodii*, *Meconopsis aculeata*, *Megacarpea polyandra*, *Myrica esculenta*, *Nardostachys grandiflora*, *Picrorhiza kurrooa*, *Plectranthus barbatus*, *Podophyllum hexandrum*, *Polygonatum cirrifolium*, *Polygonatum verticilatum*, *Potentilla fulgens, Rheum australe*, *Rheum moorcroftianum*, *Satyrium nepalense*, *Selinum wallichianum*, *Skimmia anquetilia*, *Swertia chirayita*, *Swertia cilliata*, *Taxus wallichiana*, *Terminalia chebula*, *T. bellirica, Rubia cordifolia*, *Tanacetum dolichophyllum*, *Thalictrum foliolosum*, *Thalictrum javanicum*, *Trigonella emodi*, *Trillidium govanianum*, *Valeriana jatamansi* and *Viola serpens* *Gloriosa superba* and *Withamia somnifera* are found in secondary scrub and in agricultural fields.

(i) Balganga Range: Gewali - 12 and 13 are recommended for the conservation of *Aconitum heterophyllum*, *Aconitum lethale*, *Allium stracheyi, Angelica archangelica*, *Nardostachys grandiflora*, *Picrorhiza kurrooa*, *Polygonatum cirrifolium* *Rheum australe, Tanacetum dolichophyllum, Trigonella emodi* and *Thalictrum foliosum.* Gewali - 15 is recommended for the development of above mentioned species in Bhotkhal Bugyal. Argad - 8 and 10 are recommended for development of *Myrica esculenta* and *Thalictrum javanicum;* Bhigon - 8 for *Berberis asiatica;* Pinswar - 3 for *Swertia ciliata* and Agunda - 4 for *Rubia cordifolia*, *Swertia chirayita*, *Valeriana jatamansii* and *Potentilla fulgens*.

(ii) Bhilangana range: Gangi-19 & 20b (Kharsoli to Bagi Bugyal) are recommended for the conservation of *Rheum australe*, *Rheum moorcroftianum*, *Aquilegia pubiflora*, *Aconitum heterophyllum*, *Aconitum atrox, Angelica archangelica*, *Angelica glauca*, *Polygonatum verticillatum*, *Maharanga emodii*, *Meconopsis aculeata*, *Selinum wallichianum*, *Tanacetum dolichophyllum*, *Taxus wallichiana*, and *Thalictrum foliosum.* Gangi- 33, 34 & 38 have good populations of *Aconitum lethale, Allium stacheyi*, *Geranium wallichianum*, *Lilium polyphyllum*, *Nardostachys grandiflora*, *Picrorhiza kurrooa*, *Podophyllum hexandrum*, *Polygonatum cirrifolium,* , *Rheum moorcroftianum*, *Selinum wallichianum*, *Swertia chirayita*, *Tanacetum dolichophyllum*, and *Trillidium govanianum* Kokalyadhar to Pawalikantha via Tali is one of the best compartments for the conservation of MAPs. Gangi Block as a while can be considered for the conservation and development of MAPs.

(iii) Lambgaon Range: Jalgurgad - 5a is recommended for the conservation of *Myrica esculenta,* Mulgad - 2 for *Rubia cordifolia a*nd *Satyrium nepalense,* and Mulgad – 2 for *Skimmea anquetilia.*

(iv) *Paukhal R*ange: Gholdani - 1 and 3 are recommended for the conservation of *Abrus precatorius, Asparagus adscendens, Hedychium spicatum*, *Skimmea anquetilia*, *Swertia ciliata*, *Taxus wallichiana*, *Thalictrum foliosum* and *Valeriena jatamansi*; Trichot - 2 and 3 for *Plectranthus barbatus, T. bellirica an*d *Terminalia chebula,*; Akhorisain – 3 for *Gloriosa superba* and *Datisca cannabina*

(v) Tehri Rang*e:* *Gloriosa superba* and *Withania somnifera* were recorded in civil land along the Tehri dam between Bhagirathipuram and Davada. Paurikhal - 3 is recommended for the conservation of *Lilium polyphyllum* and *Valeriena hardwickii*. Kaudiya 9b can be considered for the conservation of *Taxus wallichiana*, *Viola serpens* and *Thalictrum javanicum*.

Tons Forest Division (TFD): The following species have been identified as priority (potential) for conservation and development in TFD: *Aquilegia pubiflora, Curculigo orchioides, Habenaria edgeworthii, Hedychium spicatum, Houttuynia cordata, Inula cappa, Jurinea dolomiea* and *Tagetus minuta* Chungadu, Dalnu and Sheru Blocks are recommended for conservation and development of most species in the Division.

(i) Devta Range: Some civil areas in the Range had rich populations of *Tagetus minuta.* This species can easily be propagated in the cultivable waste and degraded sites.

(ii) Purola Range: Dalmu Block is recommended for conservation and development of *Hedychium spicatum* and *Houttuynia cordata,* and Gundiatgaon Block for *Habenaria edgeworthii.*

(iii) Singtoor Range: Aura Block in this Range is rich in Lakaddhup (*Jurinea dolomiea*). Chungadu Block can be considered for conservation and development of *Curculigo orchioides* and *Inula cappa*.

Upper Yamuna Forest Division (UYFD): Sixteen species viz., *Aconitum lethale, Aquilegia pubiflora, Berberis asiatica, Caltha palustris, Dactylorhiza hatagirea, Habenaria edgeworthii, Habenaria intermedia, Inula cappa, Jurinea dolomiea, Paeonia emodii, Podophyllum hexandrum, Polygonatum verticillatum, Skimmea anquetilia, Swertia cilliata, Taxus wallichiana* and *Zantoxylum armatum* have been identified for Conservation, development and Harvest (CDH) plan in the various Ranges of the Division.

(i) Kuthnor Range: Kupra Block is recommended for conservation and development of *Aquilegia pubiflora, Valeriana jatamansii* and *Paeonia emodii;* Pali Block for *Habenaria intermedia.*

(ii) Mugarsanti Range: Molda and Devrana Blocks are rich in *Berberis asiatica* and *Zantoxylum armatum* and can be taken up for further conservation planning. Bhatiya Block is recommended for conservation and development of *Valeriana jatamansi*.

(iii) Rawain Range: Pathargad, Patangani and Biyali Blocks are ideal sites for conservation and development of *Valeriana jatamansi, Berberis asiatica* and *Habenaria edgeworthii.* Near Kanda Village in Bigradi Beat, 50-70 individuals m^{-2} of *Acorus calamus* were found in 5 different patches in addition to patch in Masalgaon beat, near Badiyar gad dam site and one in compartment 2 in Rikhanad beat. Hence, these areas are recommended for further conservation and harvest of this species.

(iv) Yamunotri Range: Digdara Block should be considered for conservation and development of *Podophyllum hexandrum, Jurinea dolomiea, Skimmia anquetilia* and *Taxus wallichiana*. Digdara, Rana and Yamanotri Blocks could be considered for conservation of T*rillidium govanianum;* Bhairab Block for *Aconitum atrox Dactylorhiza hatagirea*, *Nardostachys jatamansi*, *Picrorhiza kurrooa*, *Aconitum hetrophyllum,* and *Polygonatum* spp., Other sites for conservation in the Range include Pali Block, Compartment 1 for *Paris polyphylla;* Yamanotri Block (compartment 7) for *Arnebia benthamii* and Yamunotri Block (compartment 7, 8 and 10) for *Meconopsis aculeata, Rheum moorcroftianum* and *Rheum webbianum. Nardostachys jatamansi* is frequent in Bhairab and Pali Blocks.

Uttarkashi Forest Division (UFD): In this Division 41 species *viz., Aconitum ferox, Aconitum heterophyllum, Allium carolinianum, Allium humile, Allium stacheyi, Anemone rivularis, Angelica archangelica, Angelica glauca, Aquilegia pubiflora, Arnebia benthamii, Berberis aristata, Berberis asiatica, Bergenia cilliata, Caltha palustris, Cinamomum tamala, Cissampelos pariera, Dactylorhiza hatagirea, Dioscorea deltoidea, Emblica officinalis, Geranium wallichianum, Hedychium spicatum, Jurinea dolomiea, Lilium polyphyllum, Malaxis acuminata, Meconopsis aculeata, Nardostachys grandiflora, Picrorhiza*

kurrooa, Podophyllum hexandrum, Polygonatum cirrhifolium, Polygonatum multiflorum, Polygonatum verticillatum, Rheum australe, Selinum wallichianum, Skimmea anquetilia, Tagetis minuta, Thalictrum foliosum, Tinospora cordifolia, Trigonella emodi, Trillidium govanianum and *Valeriena jatamansi* have been identified for Conservation, development and Harvest (CDH) plan in various Ranges. Dodital, Dichli, Dhanari, Harshil, Suki and Gangnani Blocks are especially rich in MAPs and have potential for further conservation and development.

(i) Badahat Range: Dodital Block hosts very important MAPs *viz., Aconitum heterophyllum, Picrorhiza kurrooa, Polygonatum cirrhifolium* and *Nardostachys grandiflora.* Therefore, this area can be considered for conservation and development of these species. Utraun Block shows good population of *Cinnamomum tamala* and can be considered for development of the species.

(ii) Dharasu Range: Dichli Block shows good population of *Skimmea anquetilia* and after re--assessment Block can be considered for sustainable harvest of the species Khurmola Block has a few scattered populations of *Lilium polyphyllum* and it needs to be considered for conservation of the species.

(iii) Dunda Range: Dunda Block has potential for production of Amla (*Emblica officinalis*). Dhanari Block is recommended for conservation and development of *Bergenia ciliata* and *Skimmea anquetilia*, whereas Ranukigad Block and Ranadi Block can be considered for conservation and development of *Berberis aristata* and *Tinospora cordifolia*, respectively.

(iv) Gangotri Range: Harshil Block is recommended for conservation and development of *Dioscorea deltoidea, Rheum australe, Picrorhiza kurrooa, Polygonatum verticillatum, Allium humile, Angelica glauca, Arnebia benthamii, Geranium wallichianum* and *Jurinea dolomiea.* Sukhi Block has potential for conservation and development of *Aconitum ferox, Aconitum heterophyllum, Allium humile, Allium stacheyi, Angelica archangelica, Arnebia benthamii, Dactylorhiza hatagirea, Jurinea dolomiea, Meconopsis aculeata, Polygonatum multiflorum,* and *Selinum wallichianum* Dharali Block can be considered for conservation and development of *Geranium wallichianum* and *Anemone rivularis.* Patangani Block, adjacent Gangotri National Park, can be selected for conservation and development of *Polygonatum verticilatum* and *Thalictrum foliosusm.*

(v) Mukhem Range: Jalkurgad Block is recommended for development of *Berberis asiatica, and* and Saura Gad for *Polygonatum verticilatum, Malaxis acuminata* and *Hedychium spicatum*.

(vi) Taknaur Range: Gangnani Block is recommended for conservation and development of *Aconitum ferox, Aconitum heterophyllum, Caltha palustris, Podophyllum hexandrum, Jurinea dolomiea* and *Trillidium govanianum;* Huri Block for *Selinum wallichianum* and *Angelica glauca;* Raithal Block for *Berberis aristata* and *Taxus wallichiana;* and Pilang Block for *Thalictrum foliosum* and *Malaxis acuminata.*

The database created and information generated through this project needs to be placed at a central location at Forest Head Quarters under the supervision of Nodal Officer Medicinal Plants in the form of an interactive portal for regular update and feedback from the field whenever more intensive quantification is done for a particular species or additional local use is recorded. Of about 97 species of medicinal plants recorded in various transects, 54 species have been prioritized for conservation and development in the region. These species along with potential Blocks and Ranges recommended for conservation and development (assisted natural regeneration) are given in Chapter-4. Chapter 4 may be taken into consideration while preparing the Working Plans for various Divisions. Decision about designating a particular Block / Range as conservation / development area for a single or group of species (as medicinal plant conservation circle) may be taken based on overall management requirements.